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## ► To cite this version:

Marysia Ogrodnik. Investigating the determinants of smoking cessation: from the desire to quit to the effective attempt. 2016. halshs-01379240

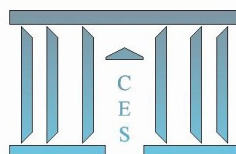
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Submitted on 11 Oct 2016

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**Investigating the Determinants of Smoking Cessation:  
From the Desire to Quit to the Effective Attempt**

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**2016.52**



# INVESTIGATING THE DETERMINANTS OF SMOKING CESSATION: FROM THE DESIRE TO QUIT TO THE EFFECTIVE ATTEMPT

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Smoking behavior involves complex mechanisms such as addiction (physical and psychological dependence, self-control, social smoking) and smoking related perceptions (self-exempting beliefs and smoking norms). The latter evolve through consumption career described by the stages of change. Those effects are tested on a sample of French smokers and ex-smokers who completed an online-survey.

A first model tests the role of addiction on the motivation to quit. The results show a strong relationship: physical and psychological dependence are positively related to the motivation to quit, as self-control is negatively related. Moreover, as cigarette consumption becomes more anchored in everyday life and more solitary, reported motivation to quit increases. The second model, studies the relationship between smoking related perceptions and motivation to quit. Results show that smoking denormalization beliefs increase, and self-exempting beliefs decrease across the smoking career.

In order to re-establish smokers' self-control, public policies should act on physical dependence (by helping consumers to adopt a smoking cessation strategy through the funding of different kind of treatments), but also on environmental cues that trigger the desire to smoke (by limiting them). The second possible strategy is to act on the relationship between smoking-related beliefs and the motivation to quit by promoting *nudges*, normative change, and moderate fear-appealing campaigns associated to high levels of efficacy and self-efficacy.

*JEL Classification:* C25, D83, I12.

*Keywords:* addiction; motivation; self-control; smoking; stages of change.

## INTRODUCTION

### *Smoking prevalence*

French public authorities invested substantial resources in order to overcome the smoking issue. During the past decade, public bans were multiplied, cigarette price has doubled, and preventive campaigns have been intensified. In response, the evolution of French cigarette consumption

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showed puzzling results. Between 2010 and 2014, among the population aged 15 to 75 years, the rate of smoking has weakly increased from 33.7% up to 34.1%, although daily smoking rate diminished from 29.1% to 28.2% (Guignard et al., 2015). In addition, daily cigarette consumption has stagnated at 11.

Abstention process involves a succession of changes including desire to quit appearance, followed by intention to quit, and effective attempt. Understand which factors enhance those evolutions and which ones hinder them is fundamental to interpret the stagnation of smoking prevalence and its tendency to increase during the last years, and to propose effective instruments that could be adopted by public authorities, in order to improve current situation.

### ***The evolution of smoking behavior: the Transtheoretical Model***

Smoking behavioral pattern has been described by the Transtheoretical Model (Abel and O'Brien, 2014; Connors et al., 2013; Prochaska et al., 2013) from initiation to final abstention, smokers follow five stages of change. The consumer who begins to smoke is in pre-contemplation stage: he does not consider himself as dependent and underestimates the noxiousness of cigarette smoking compared to other smokers and non-smokers. The contemplation stage corresponds to the emergence of an ambivalence: however, he admits that smoking could have negative impact on his life; he only expresses a desire to change in the long run. Then comes the preparation stage when self-control issue appears leading the consumer to plan to quit cigarette within the six months. An effective attempt to abstain from smoking drives him into the action stage (abstention for less than six months) and then the maintenance stage (abstention for more than six months).

Some factors should naturally push the smoker into the next stage. Indeed, as cigarette consumption increases and becomes anchored in the smoker's everyday life, he realizes that he has developed a dependence and has less control over his smoking behavior, which enhances successively the desire to quit, the intention to quit, and the effective attempt. However, addiction is also an impediment to a smoking cessation success that can trap the individual in preparation stage. Moreover, as described below, some cognitive mechanisms such as self-exempting beliefs

or the perception that smoking is socially approved also intervene to slow down the stage of change succession, and can even cause a return to a previous stage.

### ***Addiction problem***

The level of addiction to cigarettes is directly linked to the motivation to quit (Prochaska et al., 1994). However, this concept is complex and covers various dimensions. First, it is associated to physical dependence described by the tolerance (an increase of the amounts smoked across time in order to get a constant satisfaction), and reinforcement (an increase of the desire to smoke) effects (Becker et al., 1994). There is also a psychological component represented by environmental cues (Upadhyaya et al., 2004). The presence of the latter increases the subjective value of the product (Hayashi et al., 2013). Those cues can be complementary good to cigarette as alcohol or coffee, or situations that were associated to cigarette consumption such as waiting in the street or boredom (García-Rodríguez et al., 2012; Van Gucht et al., 2010). Combined together physical and psychological addiction to a product induce self-control problems that explain why quitting attempts often fail (Hagger et al., 2013; Kim et al., 2014; Vangeli et al., 2011). Indeed, Cigarettes belong to a category of goods that are associated to visceral effects (Loewenstein, 1996). The latter arise when the amounts smoked are insufficient considering the level of addiction, and make the consumer suffer. The only way to get rid of this sufferance is to smoke more. He can therefore be “forced” to smoke even if he does not want to, losing his self-control. In case of an addictive consumption, visceral effects are intensified by repeated consumption, as well as by environmental cues. This lack of self-control is a predictor of the motivation to quit (de Ridder et al., 2012) but also a factor of failure in quitting attempts. The last dimension of addiction to cigarette is the level of social smoking, which is firstly a social activity associated to less nicotine dependence and less intention to quit (Moran et al., 2004; Song and Ling, 2011). With time, it becomes more and more a solitary habit as cigarette consumption becomes anchored in everyday life.

### ***Smoking related-perceptions***

Prevention campaigns induce a cognitive dissonance among smokers (Festinger, 1957) between their cognitions (the information that smoking is dangerous), and their behavior (smoking). This dissonance induces a state of tension that the individual resolves via behavioral adaptation – by

quitting smoking – or, when it is not immediately possible, by cognitive rationalization – by manipulating his beliefs (Goethals, 1986; Kruglanski, 1989; Kruglanski and Ajzen, 1983; Shah and Oppenheimer, 2008). The result is that “many addicts deny that they have a problem or, if they admit it, deny that they can do anything about it” (Elster, 2000). Many smokers show unrealistic optimism (Weinstein et al., 2005), and self-exempting beliefs, especially in precontemplation stage (Oakes et al., 2004). The problem is that dissonance reduction in the form of denial or distortion of threatening information affects the readiness to change and delay the decision to quit (Dillard et al., 2006; Oakes et al., 2004; Radtke et al., 2011). In addition, the perceived norm of smoking also appears to be related to the motivation to quit. The more the smoker is ready to change, the less he perceives that smoking is a valued behavior (Mourre and Gurviez, 2015; Zhang et al., 2010). Indeed, injunctive norms, more than descriptive norms (van den Putte et al., 2005) are good predictors of individual smoking behavior (Steele et al., 2002). Smokers who attempt to quit are very supportive of anti-smoking policies (Amador and Nicolás, 2013).

### ***Paper objectives***

Few studies have distinguished the different steps involved in the motivation to quit smoking, i.e. the desire, the intention and the effective attempt to quit. In addition, no paper analyzing the link between different dimensions of addiction (dependence, environmental cues, social smoking and perceived self-control) and motivation to quit has been found. Thereby, the first study (model 1) aims to establish the impact of those factors on the different levels of motivation to quit. Moreover, existing studies about the evolution of smoking related perceptions (regrouping self-exempting beliefs and the injunctive norm of smoking) across the smoking career are scarce (Bursey and Craig, 2000). In order to overcome this weakness, a second study (model 2) links those variables to the whole stage of change succession.

It is assumed that the power of physical dependence and environmental cues to trigger the desire to consume is increasing through the smoking stages of change, whereas reported self-control decreases and the smoking habits becomes a solitary activity through a decrease of social smoking (model 1). It is also hypothesized that, from smoking initiation to abstention, self-exempting beliefs weaken, and smoking denormalization reinforces (model 2).

## **MATERIAL AND METHODS**

### ***Survey procedure***

The invitation to respond to the self-administered questionnaire has been spread on social networks via snowball sampling (Goodman, 1961) between March and May 2013. It included a brief description of the survey, instructions on how to complete it and a direct internet link. The condition of eligibility was past or present smoking experience and to be aged 15-65. Population aged 66 and more have been excluded from the analysis due to a weak access to the Internet (Gombault, 2013).

The questionnaire electronic format permits to show or to hide some questions according to the respondents' characteristics. Thereby, ex-smokers do not answer to questions concerning current smoking behavior. The online administration also avoids the duplication of cases by IP tracking, and prevents the problem of missing values by implementing forced responses (nonetheless this also causes drops out that are not measured). The online surveys also permit to avoid a part of interview biases such as social desirability (Crowne and Marlowe, 1960; Kiesler and Sproull, 1986), and the recruitment process on social networks increases respondent level of confidence since the researcher shows his personal information (profile) and participates to the groups (Baltar and Brunet, 2012). Moreover there is no significant difference between the response of smokers who has an access to the Internet and smokers who has not (Bigot et al., 2013; Nagelhout et al., 2010).

Participant who clicked on the link, read an introduction reminding the scope of the survey, after which the questions were asked. In order to alleviate the problem of non-representativeness of the sample generated from snowball sampling, the initial sample was as much representative as possible e.g. from different age groups, geographical regions, and professions (Morgan, 2008). Despite this representativeness issue, online recruitment is a suitable strategy for studying adults smokers behavior (Bauermeister et al., 2012; Klein et al., 2007; Ramo et al., 2011; Ramo and Prochaska, 2012). However, the results cannot be generalized to the whole population.

## ***Survey measures***

### Dependent variable : Stage of change

Respondents are first associated to a stage of change, the dependent variable (Prochaska et al., 1985): (a) precontemplation, for those who answered “no” to the question “would you like to quit smoking?”; (b) contemplation when they answered “yes” to the previous question and “no” to the question “do you plan to quit smoking within the six months?”; (c) preparation if they answered “yes” to both questions<sup>2</sup>; and (d) action-preparation stages, for respondents who reported to be ex-smokers.

### Independent variables

#### *Addiction measures (model 1)*

Four measures are computed to indicate respondents’ level of addiction to cigarettes, and concerns only current smokers (in precontemplation, contemplation and preparation stages).

Physical dependence is measured through the heaviness smoking index – HSI (Heatherton et al., 1989) composed of the addition of two items: the daily cigarette consumption (0=10 or less, 1=11-20, 2=21-30, 3=31 and more) and the duration between wake up and the first cigarette (0=more than 60 min, 1=31- 60 min, 2=6-30 min, 3=5 min or less). The score (from 0 to 6), is considered to be a good brief screen for high nicotine dependence (Borland et al., 2010; Pérez-Ríos et al., 2009).

Sensitivity to environmental cues is measured by asking the smokers which of the situations, proposed in García-Rodríguez et al. (2012) usually enhance their cigarette consumption (0=no, 1=yes): “drinking coffee”, “eating”, “making a pause during work”, “relaxing time”, “boredom”. The score (from 0 to 5) is the addition of the responses to the items and shows a satisfactory internal consistency (Cronbach  $\alpha=0.72$ ). Indeed, the amounts of contexts triggering the desire to smoke is a good indicator of the level of addiction (Van Gucht et al., 2010). Self-control over tobacco consumption is assessed through the item “I can easily control my cigarette consumption when I am in a situation of craving” (0=never, to 10=always). The last component of addiction is

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<sup>2</sup> No respondent reported to plan quit smoking and not to desire quit smoking. Otherwise, the agent would be placed in preparation stage. This kind of situation can occur for instance when the smoker cannot afford cigarettes anymore, or when he feels too much pressure to quit from his relatives.



the propensity to smoke with peers (0=0% of cigarettes consumed, to 10: 100% of cigarettes consumed).

#### *Markers of denormalization (model 2)*

Respondents' perception of the smoking norm is appraised by two variables. The injunctive norm is an indirect measure. It is assessed by questioning respondents on how they think that smokers are generally perceived (0=totally disagree, to 4=totally agree) through items retrieved from Chapman and Freeman (2008) : “people think that smokers are selfish”, “people think that smokers are less productive”, “people think that smokers are excessive users of public health services”, “people think that smokers are litterers”. The items of the environmental cues scores (from 0 to 16) show a correct internal consistency (Cronbach  $\alpha=0.73$ ). A second measure of smoking denormalization is more direct and refers to the level of disturbance caused by second-hand smoke (0=not bothered at all, to 10=very bothered).

#### *Perceived cigarette noxiousness (model 2)*

Just like markers of smoking denormalization, personal vulnerability to cigarette noxiousness is evaluated directly and indirectly. Oakes et al. (2004) item measuring bulletproof smokers belief “I think I must have the sort of good health or genes that means I can smoke without getting any of the harms” is used here to assess the direct perception of the respondent vulnerability. The end of sentence is reformulated to “... that means I'm not sensitive to smoking harms” (1= totally disagree, to 10=totally agree), in order to be applicable for ex-smokers. Evaluation of the percentage of lung cancer cured (0=0% to 10=100%) is an indirect manner to measure the perceived level of vulnerability to smoking noxiousness (Weinstein et al., 2005).

#### *Statistical analysis*

All statistics analyses were performed of R software. Effects were considered significant at  $\alpha$  level of 0.05 or less. First, for each model, the relationship between the dependent variable and the independents variables was examined through bivariate analyses. Factorial ANOVAs were used for continuous variable whereas Pearson chi square tests were done for categorical variables. Afterwards, logistic regressions are run in order to test the hypotheses made in 1.6.

## Descriptive statistics

### *Participants general features*

The sample is made up of the N=269 French participants (54.3% female), with a mean age of 32.4 years (s.d.=13.5). Among those participants, 66.9% reported to be smokers (occasional and daily smokers): 28.6% of the total sample is in pre-contemplation stage (42.7% of current smokers), 20.8% is in contemplation stage (31.1%) and 17.5% in preparation (26.1%). Those proportions are similar to those found by the INPES<sup>3</sup> (Guignard et al., 2015) for 2014. The remaining 33.1% reported to be ex-smokers, which is less than in the INPES study<sup>4</sup>, probably due to the over-representation of young respondents.

Whereas gender is not related to the smoking stage ( $\chi^2(3)=3.62$ ,  $p=.302$ ), it is not surprising to observe that age shows a significant relation ( $F(3,365)=35.87$ ,  $p<.001$ ). Indeed, most smokers begin young, and individuals who reach their mid-20 as non-smokers are unlikely to become smokers (Aldrich et al., 2015). Thus, age can be directly related to consumption history. Moreover, stages of change follow each other during the consumption career. As for consequences the more the smoker ages, the more he has chances to be in a more advanced stage.

**Table 1 - Participant characteristics**

Variable	Precontemplation	Contemplation	Preparation	Action Maintenance	$\chi^2$	p-value
	No. (%)	No. (%)	No. (%)	No. (%)		
Respondents	77 (29.6)	56 (20.8)	47 (17.5)	89 (33.1)		
Female	41 (53.2)	26 (46.4)	24 (51.1)	55 (61.8)	$\chi^2(3)=3.62$	0.302
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	F	p-value
Age	24.5 (10.8)	27.1 (10.4)	34.2 (12.2)	41.6 (21.1)	$F(3,365)=35.87$	<0.001

### *Addiction measures (model 1)*

As expected, a more advanced stage of change is associated with a higher HSI ( $F(2,177)=21.57$ ,  $p<0.001$ ), a greater sensitivity to environmental cues ( $F(2,177)=16.70$ ,  $p<0.001$ ), a lower self-

<sup>3</sup> According to Guignard et al. (2015), 59.5% of smokers report a desire to quit. Therefore 40.5% (1-0.595) are in precontemplation stage. Moreover, 27.3% plan to quit within six months, so they are 32.2% (0.595-0.273) in contemplation stage and 27.3% in preparation stage.

<sup>4</sup> Compared to Guignard et al. (2015) study, ex-smokers are underrepresented in the present study (33.1%) versus 47.6% (when non-smokers are excluded from the sample).

control over cigarettes consumption ( $F(2,177)=28.21$ ,  $p<.001$ ), and a smaller propensity to smoke with peers ( $F(2,177)=17.85$ ,  $p<.001$ ).

#### *Markers of denormalization (model 2)*

Bivariate analyses showed that injunctive norm deteriorates ( $F(3,265)=9.39$ ,  $p<.001$ ), and that the level of discomfort caused by smoke increases ( $F(3,265)=15.77$ ,  $p<.001$ ) through the stages of change.

#### *Perceived cigarette noxiousness (model 2)*

Perception of the amount of lung cancers cured ( $F(3,265)=12.17$ ,  $p<.001$ ) as well as the role of luckiness as a factor of protection from the danger ( $F(3,265)=9.40$ ,  $p<.001$ ) are significantly related to the stage of change.

**Table 2** - addiction, smoking norm and self-exempting beliefs among the stages of change

Variable	Precontemplation	Contemplation	Preparation	Action Maintenance		
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)	F-value	p-value
Heaviness smoking index	0.78 (1.16)	1.73 (1.42)	2.43 (2.42)	-	$F(2,177)=21.57$	$<0.001$
Environmental cues	2.09 (1.63)	2.92 (1.58)	3.76 (1.47)	-	$F(2,177)=16.70$	$<0.001$
Self-control	6.40 (2.71)	4.48 (2.38)	3.14 (1.82)	-	$F(2,177)=28.21$	$<0.001$
Smoking with peers	6.92 (2.48)	5.77 (2.42)	4.29 (2.14)	-	$F(2,177)=17.85$	$<0.001$
Injunctive norm	4.97 (3.13)	5.25 (2.85)	6.23 (3.47)	7.44 (3.50)	$F(3,265)=9.39$	$<0.001$
Discomfort caused by smoke	4.09 (2.77)	4.09 (2.08)	5.38 (2.97)	6.56 (2.60)	$F(3,265)=15.77$	$<0.001$
Percentage of lung cancers cured	4.54 (2.07)	3.52 (1.88)	3.66 (2.29)	2.72 (1.66)	$F(3,265)=12.17$	$<0.001$
Luckiness as a protection factor	5.22 (2.88)	4.66 (2.94)	4.36 (2.83)	3.07 (2.57)	$F(3,265)=9.40$	$<0.001$

#### Logistic regression

A cumulative logistic regression model (using ordered variable response), has been chosen for two studies. Such a specification permits to compare a set of groups (stages of change) to all the groups that are below. If there are K groups, K-1 logits are computed by using the following

$$\text{equation: } LOGIT(P(Y > k|X)) = \ln \frac{P(Y > k|X)}{P(Y \leq k|X)} = a_0 + a_1X_1 + \dots + a_jX_j, \quad k = 1, \dots, K - 1$$

were coefficients  $a_{j,k}$  can be read as follows: when a variable  $X_j$  increases by  $\Delta$ , the different LOGIT increase by :  $\forall k, LOGIT_k(X_j + \Delta) - LOGIT_k(X_j) = \hat{a}_{j,k} \times \Delta$ .

### *Test for parallel lines assumption*

Cumulative logistic models work under parallel lines assumption: each cumulative logit has its own intercept and model assumes the same effects for each logit. Thereby, effects are simple to summarize since each predictor is accompanied by one single parameter. Each cumulative odds ratio is proportional to the distance between the  $X_j$ . The same proportionality constant applies for each logit (Agresti and Kateri, 2011). Here, a likelihood ratio test is used to test the parallel lines assumption. In other words, the following assumption is tested (Erkan and Yildiz, 2014):

$$H_0 = a_{j,1} = \dots = a_{j,K-1} = a_j, \quad k = 1, \dots, K - 1$$

If parallel lines assumption does not hold for at least one variable, the assumption is breached.

For both regressions, likelihood ratio tests of the proportional odds assumption permit to find that there is no evidence of non-proportional odds for any independent variable. Results are presented in tables 3 and 4, and are accompanied by indicators of goodness of fit (Akaike Information Criteria, and deviation measure e.g. LogLikelihood). This suggests that there is a linear relationship between the stage of change and the independent variables in both models.

**Table 3** - Likelihood ratio tests of the proportional odds assumption - Model 1

Variable	Df	LogLik	AIC	LRT	p-value
<None>	-	-153.82	319.65	-	-
HSI	1	-153.51	321.01	0.6332	0.4262
Environmental cues	1	-153.14	320.29	1.3602	0.2435
Smoking with peers	1	-153.79	321.58	0.0679	0.7944
Self-control	1	-153.78	321.57	0.0778	0.7803

**Table 4** - Likelihood ratio tests of the proportional odds assumption - Model 2

Variable	Df	LogLik	AIC	LRT	p-value
<None>	-	-316.08	646.16	-	-
Injunctive norm	2	-315.12	648.25	1.9141	0.3840
Discomfort caused by smoke	2	-314.04	646.07	4.0883	0.1295
Percentage lung cancers cured	2	-314.87	647.74	2.4190	0.2983
Luckiness as a protection factor	2	-315.08	648.75	2.0084	0.3663

### *Check for multicollinearity*

The degree of multicollinearity of the independent variables is measured by the Variance Inflation Factor (VIF). For each variable  $k$ , it corresponds to:  $VIF(\hat{\alpha}_k) = \frac{1}{1-R_k^2}$  where  $R_k^2$  corresponds to the unadjusted coefficient of determination. The latter is obtained by running a linear regression using  $k$  as the response variable (Hendrickx et al., 2004). From each regression, VIF values are manually computed. The results are provided in tables 5 and 6.

**Table 5** - Check for predictors multicollinearity - Model 1

Dependent variable	Independent variables	Coefficient of determination	VIF
HSI	Environmental cues, Smoking with peers, Self-control	0.2444	1.3235
Environmental cues	HSI, Smoking with peers, Self-control	0.1693	1.2038
Smoking with peers	HSI, Environmental cues, Self-control	0.2129	1.2705
Self-control	HSI, Environmental cues, Smoking with peers	0.2902	1.4088

**Table 6** - Check for predictors multicollinearity - Model 2

Dependent variable	Independent variables	Coefficient of determination	VIF
Injunctive norm	Discomfort caused by smoke. Percentage of lung cancers cured. Luckiness as a protection factor	0.1194	1.1356
Discomfort caused by smoke	Injunctive norm. Percentage of lung cancers cured. Luckiness as a protection factor	0.0949	1.1049
Percentage lung cancers cured	Injunctive norm Discomfort caused by smoke. Luckiness as a protection factor	0.0932	1.1027
Luckiness as a protection factor	Injunctive norm. Discomfort caused by smoke. Percentage of lung cancers cured. Luckiness as a protection factor	0.0893	1.0981

All VIF values are smaller than 10 so there is no multicollinearity between the dependent variables (Hair et al., 2006; Menard, 1995).

## **RESULTS**

### ***Model 1: The role of addiction factors on the motivation to quit smoking***

As assumed, HSI increases from precontemplation to preparation stage (OR=1.38,  $p=0.004$ ), as well as environmental cues presence (OR=1.32,  $p<0.001$ ). At the other side, smoking with peers becomes less frequent (OR=0.84,  $p=0.011$ ), and reported self-control over consumption slumps (OR=0.78,  $p<0.001$ ).

**Table 7** - Cumulative logistic regression (one smoking stage vs. previous stages) – Model 1

Variable	OR	95% CI	p-value
HSI	1.38	(1.10, 1.72)	0.004**
Environmental cues	1.32	(1.09, 1.60)	<0.001***
Smoking with peers	0.84	(0.74, 0.96)	0.011*
Self-control	0.78	(0.68, 0.90)	<0.001***

OR= Odd-ratio, CI= confidence interval, levels of significance: \* <0.05, \*\*<0.01, \*\*\* <0.001.

### **Model 2**

Smoking injunctive norm worsens (OR=1.12,  $p<0.001$ ), and individuals reports to be more bothered by smoke as they evolve through the stages of change (OR=1.26,  $p<0.001$ ). Perception of dangerousness of smoking, and bulletproof beliefs are less strong: the perceived percentage of lung cancer cured decreases (OR=0.76,  $p<0.001$ ) and luckiness is less perceived as a factor of protection from danger (OR=0.89,  $p=0.005$ ).

**Table 8:** Cumulative logistic regression (smoking stages vs. previous stages) – Model 2

Variable	OR	95% CI	p-value
Injunctive norm	1.12	(1.03,1.19)	<0.001***
Discomfort caused by smoke	1.26	(1.16,1.38)	<0.001***
Percentage lung cancers cured	0.77	(0.68,0.86)	<0.001***
Luckiness as a protection factor	0.89	(0. 81,0.96)	0.005**

OR= Odd-ratio, CI= confidence interval, levels of significance: \* <0.05, \*\*<0.01, \*\*\* <0.001.

## **DISCUSSION AND CONCLUSION**

The results of the first study demonstrate a relationship between addiction and the motivation to quit. Motivation to quit is induced by the awareness that addiction is increasing (through an increase of the physical dependence) and that consumption is more solitary and anchored in everyday life (an increasing amount of elements from environment are associated to smoking). Finally, losses of self-control overconsumption lead the agent to consider to stop smoking. On the other side, those factors are also an obstacle for a quitting success. Facing such a contradiction between what the consumer wants to do, and what he actually does, *nudges*, i.e. approaches to law and policy that maintain freedom of choice and at the same time steer people in given

directions (Thaler and Sunstein, 2009), retain attention. They are a very hot topic that captured attention of researchers, as well as policy makers with the creation of Behavioral Insight Team<sup>5</sup> in the United Kingdom, or the recent Obama<sup>6</sup> executive order toward an application of behavioral science in public policies. According to Reisch and Sunstein (2016), *nudges* aiming to discourage smoking behavior are accepted in most European countries examined, among which France, but less than other *nudges* since smoking is still a socially accepted behavior. Deposit programs<sup>7</sup> are for instance an effective strategy to quit smoking (Giné et al., 2010), although they are less attractive than an award program (Halpern et al., 2016). Other interventions permitting to re-establish individual self-control aim to diminish environmental cues. They include smoking bans (Boes et al., 2015; Kan, 2007), making smaller cigarette pack available (Marti and Sindelar, 2015) with a unitary price similar to bigger packages, or making substitutions treatments more available (Cornuz et al., 2006; Hoogendoorn et al., 2010).

The second study shows that the different perceptions associated to smoking activity, are worsened as the individual evolves throughout the stages of changes. Injunctive norms about smoking worsen, as the cigarette smoke becomes more and more disturbing. On the other side, perceived danger of smoking increases as the individual gets closer to the effective abstention, and self-exempting beliefs weaken as the individual reaches a stage in which he is be less concerned by the danger. However, there is no evidence about the direction of causality i.e. if the modification of the perception causes the change in stage (behavioral adaptation), or if the change in stage causes the modification in perceptions (cognitive adaptation). As for consequences, this point needs further investigations in the context of a longitudinal study.

In the first case (behavioral adaptation), policies aiming a normative change would be effective in reducing smoking behavior by accelerating the abstention desire, plan and attempt. Use mass media campaign in order to change indirectly social norms works for health behavior (Wakefield et al., 2010) among which smoking behavior (Lazuras et al., 2012), but this method requires to be

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<sup>5</sup> <http://www.behaviouralinsights.co.uk/>

<sup>6</sup> <https://www.whitehouse.gov/the-press-office/2015/09/15/executive-order-using-behavioral-science-insights-better-serve-american>

<sup>7</sup> Commitment contracts consists on registering on a platform as stick.com where the individual fixes his objective (here stop smoking), a deadline, a way to verify that he attained his objectives (for instance a cotinine blood test in a given laboratory). Then he put money in a virtual account, that he will only get back if he attains his objective.

careful about stigmatization by accompanying population at risk. Indeed, stigma can be a barrier for help-seeking (Brown-Johnson and Popova, 2016; Clement et al., 2015). Social stigma can also lead to unintended consequences such as “guilt, loss of self-esteem, defensiveness and resolve to continue smoking” (Bell et al., 2010; Dunlop et al., 2014) that prevent the smoker from a long term cessation.

In the second case, cognitive adaptation prevents the individual from relapse to a previous stage, but it also means that in case of relapse, perception will also adapt. Thus solution would be to use fear campaigns that follow the extended parallel process model (Witte, 1992; Witte and Allen, 2000) recommendations, i.e. inducing a moderate level of fear and enhancing high degree of self-efficacy and response efficacy (Gharlipour et al., 2015; Peters et al., 2013). Self-efficacy and response efficacy are strengthened when the fear-appealing message is accompanied by the proposition of credible solutions providing support to an abstention from addictive consumption, that consumer would feel able to put in place reinforcing his self-efficacy. Therefore, accessibility of quitting strategies (i.e. the cost of avoidance and rehabilitation strategies) plays a key role. For instance, propose quitting lines are an effective device to help motivated smokers to quit (Inpes, 2016; Lichtenstein et al., 2010; Neri et al., 2016; Nguyen-Thanh and Arwidson, 2012), however, this device is scarcely used (Kaufman et al., 2010).

Since the external validity from online samples is unknown (Barratt et al., 2015), the present research has been conducted without losing sight of the fact that the results cannot be inferred or generalized beyond the sample itself. However, our conclusions provide a trail for further researches on larger and more representative populations.



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